

Stability and movement behavior of soil and rock masses can be determined by the use of borehole extensometers. A typical rod extensometer consists of a reference head, usually installed at the collar of a drill hole, and one or more in-hole anchors, each of which is fixed in place at a known depth in the borehole. As the soil or rock deforms, the distances between adjacent in-hole anchors change, as do the distances between the individual in-hole anchors and the reference head. This allows an accurate determination of distribution, magnitude, rate and acceleration of deformation in the rock or soil mass intersected by the drill hole.



#### FEATURES

Accurate and reliable	Simple to operate
Easily adapted to remote readout	Easy to install
Anchor lengths can be varied in the field	Rugged

#### FUNCTIONS

Monitoring deformation around underground excavations.	Subsidence over mines, tunnels, etc.
Consolidation settlement in soils.	Pile load tests.
Bottom heave in open cut excavations.	Monitoring of mine pillar deformation.
Strain in concrete structures.	Deformation of foundations in and under buildings.
Movement behind the face of excavated slopes.	Roof and wall stability in mines and underground workings.



Specifications may change without notice. EXB0004C

**ROD TYPE MULTIPLE POINT BOREHOLE EXTENSOMETERS (MPBX)**



**RST Instruments Ltd.**  
 200 - 2050 Hartley Ave., Coquitlam, BC Canada V3K 6W5  
 Telephone: +1-604-540-1100 • Facsimile: +1-604-540-1005  
 Toll Free (USA & Canada): 1-800-665-5599  
 Email: info@rstinstruments.com  
[www.rstinstruments.com](http://www.rstinstruments.com)

The RST Instruments Management System is certified to ISO 9001:2000



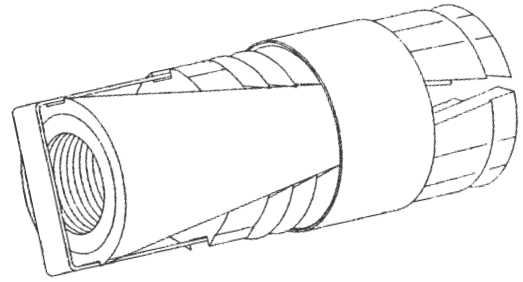
## SELECTION OF ROD EXTENSOMETERS

RST Rod Extensometers can be appropriately selected for each specific application by choosing anchor type, number of anchors (number of measurement points), anchor depths, rod type and reference head type.

## ANCHOR TYPES

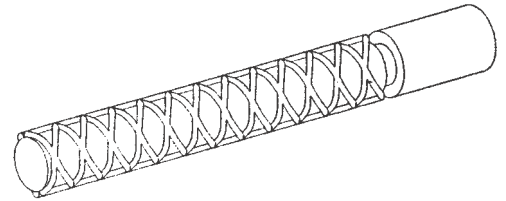
### EXPANDING SHELL ROCK BOLT ANCHOR

Preferred for single and double point extensometers, it is simple and quick to install. Wide expansion and positive mechanical set make it useful in rough, uneven boreholes within fractured rock. Also suitable for use in areas affected by blasting, and in upward or downward holes.



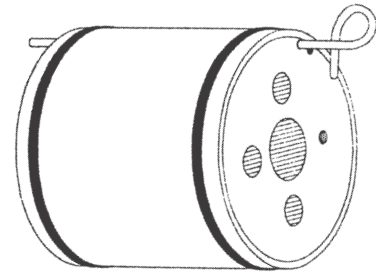
### GROUTABLE ANCHOR

Simple to install and the preferred anchor for downward directed holes. It is unaffected by blasting. It is not suitable for use in soft ground or soil as the grout column may inhibit performance. It can be used in upward directed holes with a special grouting technique. Up to six can be placed in a single 3 in. (NX) borehole.



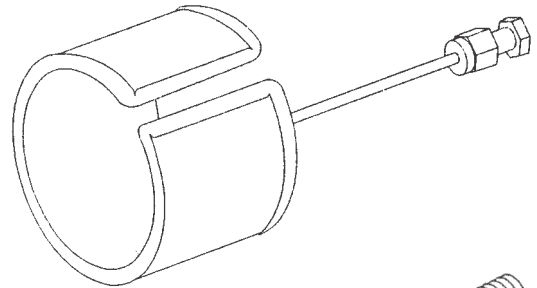
### SNAP RING ANCHOR

For use in hard, competent rock, where smooth, uniform boreholes can be drilled. It offers the optimum in speed and simplicity of installation, and up to eight can be placed in a single 3 in. (NX) borehole. It is preferred for upward holes where grouting may be difficult. It is not likely affected by blasting. Snap ring anchors are borehole size specific and must therefore be custom sized to each hole.



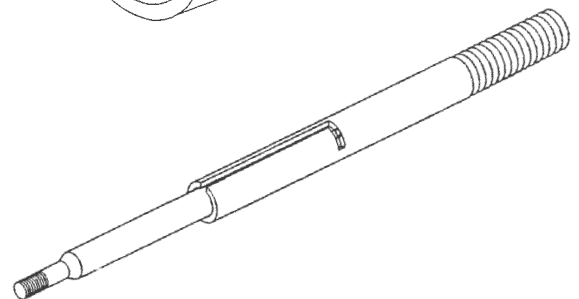
### HYDRAULIC ANCHOR

For use in soft ground and soil, especially where hole squeezing is anticipated. It is the most difficult to install and is not suitable in blast affected areas. Three types are available: the standard expanding tube type, single acting borros prong type, and double acting borros prong type. Up to six can be placed in a single 3 in. (NX) borehole.



### BAYONET MODIFICATION FITTING

A special bayonet modification fitting is available for all anchor types. This allows the measurement rod to be disconnected from the anchor and moved a known distance. With this feature the frictional effects and freedom of rod movement can be examined at any time and the reliability of readings greatly increased. Also available is an anchor tell-tale. This can be attached to the bottom of the anchor in such a way that it will project into an underground opening when the opening is excavated. This enables the extensometer to be accurately located at its lower end without resorting to expensive borehole surveying procedures.

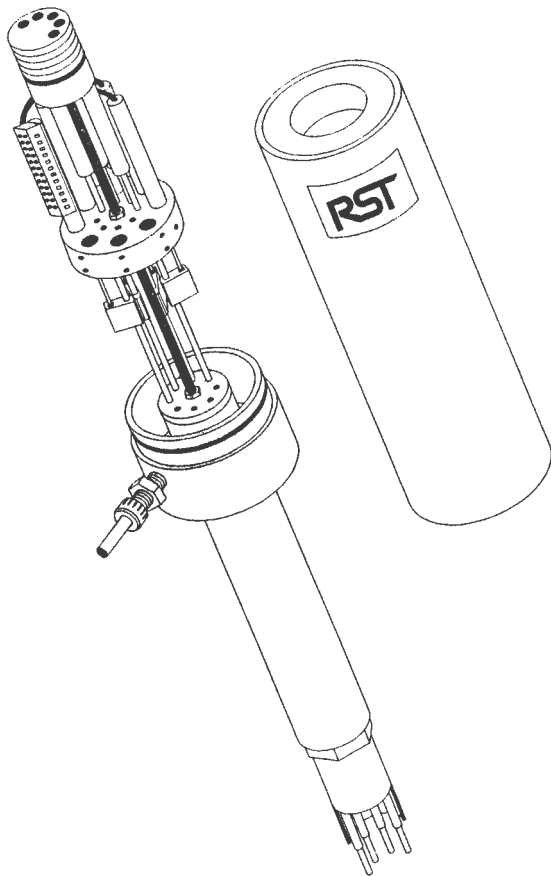


## NUMBER OF ANCHORS & ANCHOR DEPTHS

The number of anchors and anchor depths should be selected based on site geology, geometry of structures in the area, and other site-specific details. The use of two, or more, anchors at various depths allows the engineer to distinguish between potentially dangerous deep seated movements and more trivial surface spalling.

## REFERENCE HEADS

Reference heads are available in either mechanical or electrical types. When there is easy access to the extensometer a mechanical reference head can be attached and displacement readings can be made with a dial indicator or a depth micrometer. If access to the borehole is difficult or if remote reading or datalogging is required, an electrical reference head may be attached. This allows displacement readings to be made with vibrating wire transducers, LVDT's or linear potentiometers. These can be read with manual read out devices, or can be connected to dataloggers for remote and continuous monitoring. A manual over-ride is available for electrical reference heads to allow manual readings to verify that the electrical system is functioning. All readouts have a standard range of 100 mm (4 in.), but alternate ranges are available as required. Standard cable for remote readouts is a direct burial rated, PVC jacketed type. Armored cable is available for mechanical protection as required.



## ROD TYPES

Rods are available from RST in various lengths, with individual rod pieces a maximum of 3 m (10 ft.), that can be coupled together to place anchors at any required depth. Typically, rods have an O.D. of 6.4 mm (¼ in.), but larger diameters are available for site specific applications (please consult RST Instruments). Rods are available from RST Instruments in 4 different types:

- I) **Steel:** short term, typically used with groutable anchors. Flush coupled.
- II) **Stainless Steel:** most common and applicable. Typically used with all anchor types. Flush coupled.
- III) **Rigid Fiberglass:** light weight allowing easy transport and installation. Non-corrosive for longevity and can be used with all anchor types. Non flush coupled.
- IV) **Carbon Fiber:** for special high temperature and changing temperature environments. The carbon-fiber has a coefficient of thermal expansion that is virtually zero ( $<0.5 \times 10^{-6}/^{\circ}\text{C}$ ), therefore eliminating any thermal effects. Non flush coupled. Can be used with all anchor types. Carbon-fiber rods are available only as special orders.

Rods may be sheathed in individual **PVC protective pipe** (nominal ¼ in. I.D.) to minimize frictional effects between different rods and between rods and the borehole wall. Protective pipe may also be filled with oil, if the borehole is inclined downward to lubricate the rods and further minimize frictional effects. **Installation tools** are available from RST Instruments. In small boreholes (less than 2 in.), snap ring anchors can be set using the measuring rod for restraint. In larger boreholes, the force required to set snap ring anchors requires the use of **installation rods**. When several anchors are employed in one borehole, self-aligning installation rods are recommended to maintain anchors in correct alignment and prevent weaving of the measurement rods. **Rod spacers** are available to space out and support longer rods. By placing rod spacers at various places along a rods' length, "sagging" is prevented and accurate measurement is assured.

## ACCESSORIES (Specify when ordering)

Dial indicator	Depth micrometers
Setting tools	Data loggers
Grout and/or bleed tubes	Rod spacers
Terminal stations	Electrical readout

## ORDERING INFORMATION (Specify when ordering)

Model/Part number	Anchor type
Number of anchors	Individual anchor depths
Rod type	Reference head type
Installation rods/tools	Borehole diameter
Accessories required	Cable length
Cable armour	Range

Environmental considerations

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## ORDERING INFORMATION

DESCRIPTION	PART NUMBER
<b>ANCHORS AND ACCESSORIES</b>	
Expanding shell rock bolt anchor	EXEX11000
Snap ring anchor (specify borehole diameter)	EXSR11000
Groutable anchor	EXMP11000
Hydraulic anchor (expanding tube type)	EXHY11000
Hydraulic anchor (borros type-single acting)	EXHY12000
Hydraulic anchor (borros type-double acting)	EXHY13000
Bayonet modification fitting (1 per anchor)	EXFI11000
Anchor tell tales	EXFI12000
<b>RODS AND ACCESSORIES</b>	
Measurement rod, 6.4 mm (¼ in.) O.D., steel X 10 ft.	EXR0251001
Measurement rod, 6.4 mm (¼ in.) O.D., stainless steel X 10 ft.	EXR0251002
Measurement rod, 6.4 mm (¼ in.) O.D., rigid fiberglass X 10 ft.	EXR0251003
Measurement rod, 6.4 mm (¼ in.) O.D., carbon-fiber x10 ft. (special order)	EXR0251004
PVC protective pipe, 6.4 mm (¼ in.) I.D., flush coupled X 10 ft.	EXP0251010
PVC protective pipe, 6.4 mm (¼ in.) I.D., non flush coupled X 10 ft.	EXR0251011
Installation rods (for boreholes>2 in.), self-aligning	EXIR002000
Installation rods (for boreholes>2 in.), non-aligning	EXIR002100
Rod spacers (specify borehole diameter)	EXIR002200
<b>REFERENCE HEADS AND ACCESSORIES</b>	
Mechanical reference head (specify no. of points)	EXMR02004
Electrical reference head (specify no. of points)	EXER02004
Linear potentiometer, 4 in. range (standard)	EXER50004
Vibrating wire displacement transducer, 4 in. range (standard)	EXER60004
LVDT, 4 in. range (standard)	EXER70004
<b>READOUT DEVICES AND ACCESSORIES</b>	
Dial indicator readout, 6 in. range	EXMR10006
Depth micrometer, 6 in. range	EXMR11006
Potentiometric manual readout device	EXER50500
Vibrating wire manual readout device	EXER60500
LVDT manual readout device	EXER70500
Data trapper logger-8 channel (16 optional)	EXER80500
CR-10 data logger	EXER90500

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